# ProLiant DL560 server technologies

technology brief



# Abstract

The HP ProLiant DL560 server is a groundbreaking, ultra-dense 4-way server designed for environments that require a high concentration of servers in a single rack. This server delivers enterprise class performance in a compact 2U form factor that uses 50 percent less rack space than most other enterprise servers on the market. This paper describes the system architecture and the many technologies HP implemented and supports in the ProLiant DL560 server to make it an excellent platform for server consolidation.

# Introduction

With continuous demands for increased computing power, a growing number of Information Technology (IT) centers are searching for cost-effective ways to deploy more servers within their existing space and to stem rising power and air conditioning costs. The ProLiant DL560 server is a groundbreaking, ultra-dense 4-way server designed for environments that require high levels of computing power while maintaining maximum cooling and power efficiency. The ProLiant DL560 server (Figure 1) delivers enterprise class performance in a compact 2U form factor that uses 50 percent less rack space than most other enterprise servers on the market. ProLiant management technology such as remote administration from a standard web browser and Insight Manager event and configuration management significantly reduce total cost of ownership.

This technology brief describes the system architecture and discusses the many technologies that make the ProLiant DL560 an excellent platform for server consolidation.

**Figure 1.** ProLiant DL560 server, front view


# System architecture

The system architecture is the key to the high level of performance and efficiency of the ProLiant DL560 server. This server shares the same chipset and basic architecture as the ProLiant DL380 G3 server; but it features the much more powerful Intel® Xeon™ MP processor. The system is based on the industry-standard ServerWorks Grand Champion LE (GC-LE) chipset. HP is the first vendor to use this chipset to develop a 4-processor server, and ServerWorks fully supports HP's 4-way implementation of the chipset.

Intel designed the GC-LE chipset (Figure 2) primarily as a highly scalable system I/O solution for the volume 2-way server market.[1] After evaluating chipset options, HP chose the GC-LE chipset for the 4-way ProLiant DL560 server because it supports the desired system features economically. The GC-LE chipset provides the combination of performance, scalability, and power efficiency customers need, and it costs significantly less than the ServerWorks Grand Champion HE chipset.

[1] ServerWorks Product Brief, www.serverworks.com/products/GCLE.html.

For hyper-dense servers, form factor dictates the memory footprint and I/O slot count. The GC-LE chipset offers an integrated memory controller that reduces board space and cost while offering excellent performance for memory capacities up to 12 gigabytes (GB). In the ProLiant DL560 server, use of direct-attach memory (Figure 3) eliminates the need for and cost of memory buffers like those used in the ProLiant DL580 Generation 2 server (Figure 4).

**Figure 2.** ServerWorks Grand Champion LE chipset architecture

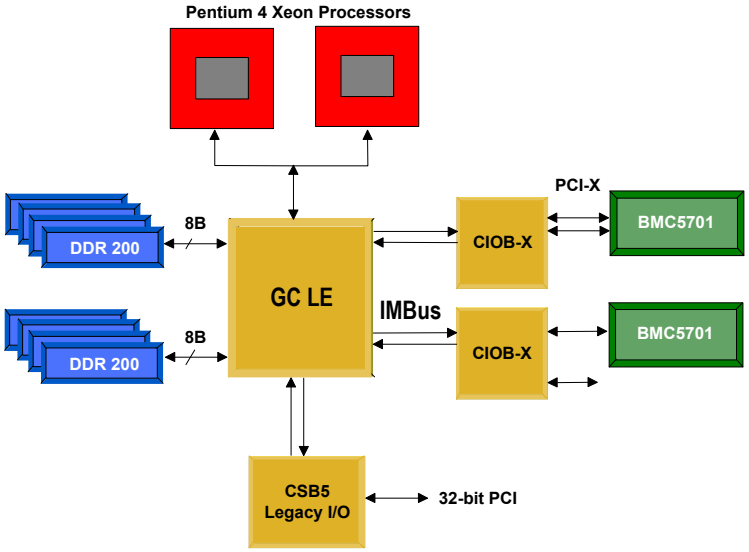



**Figure 3.** Block diagram of the ProLiant DL560 system architecture

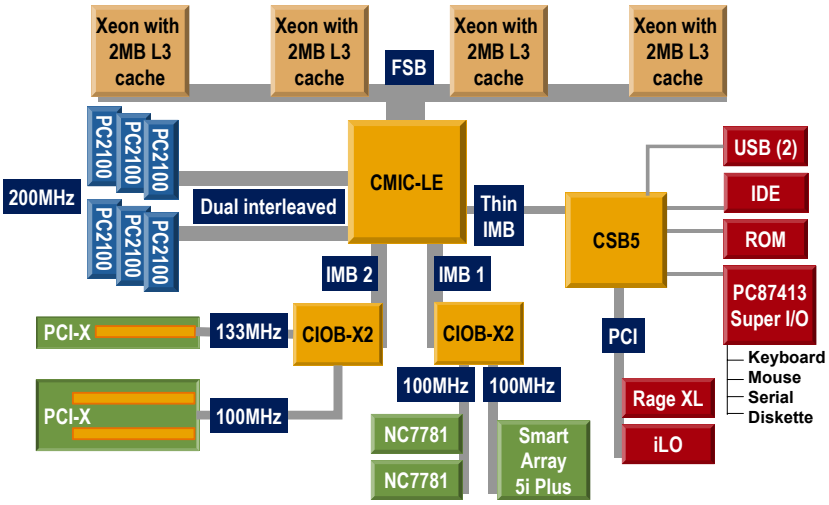
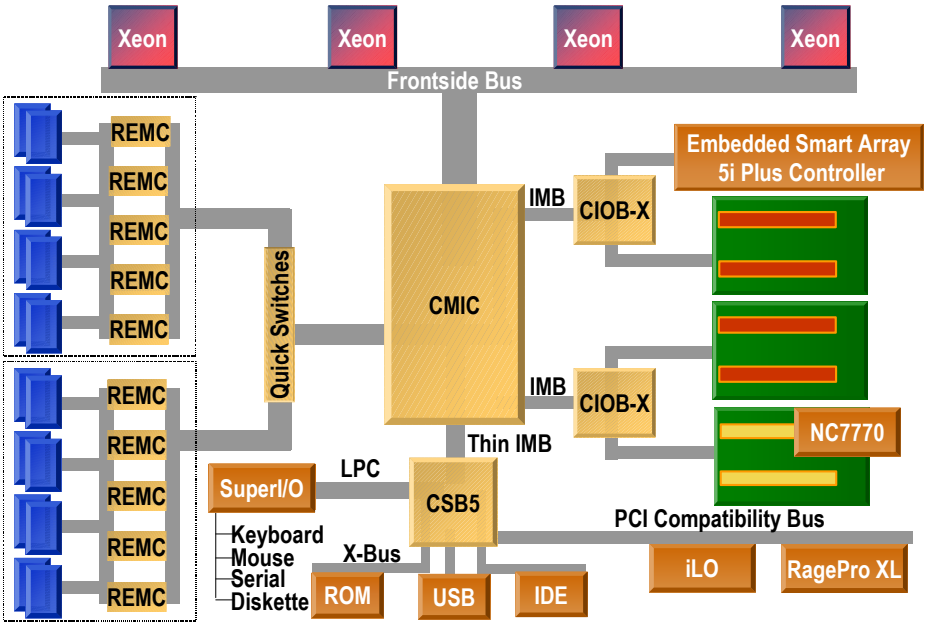


**Figure 4.** Block diagram of the ProLiant DL580 G2 system architecture



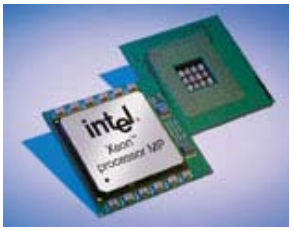

The ProLiant DL560 server has a tool-free and virtually cable-free internal design. Essential features of the server architecture include:

- Up to four Intel Xeon MP processors
- 400-MHz front side bus
- Intel Hyper-Thread technology for optimized performance
- DDR SDRAM memory with Advanced Memory Protection technology
- PCI-X architecture
- Wide Ulltra320 SCSI technology
- Gigabit networking technology
- Embedded technologies
- Hot-plug technology
- Flexibility of high line or low line AC power
- Support for today's leading industry-standard operating systems

## Processor subsystem

Models of the ProLiant DL560 server ship standard with one or two Intel Xeon processors MP (right). For first generation DL560 servers, customers may choose from available processor speeds of 1.50, 1.90, 2.00, 2.5, or 2.8 gigahertz (GHz). The 400-MHz system bus, which is quad-pumped and runs off a 100-MHz system bus clock, provides data transfer rates of up to 3.2 gigabytes per second (GB/s).

Intel Xeon MP processor




The Intel Xeon Processor MP is manufactured using a 130-nanometer (0.13-micron) process to allow higher frequencies and better performance. The term *0.13 micron* refers to the circuit (feature) size. By reducing the feature size, processor manufacturers can pack more

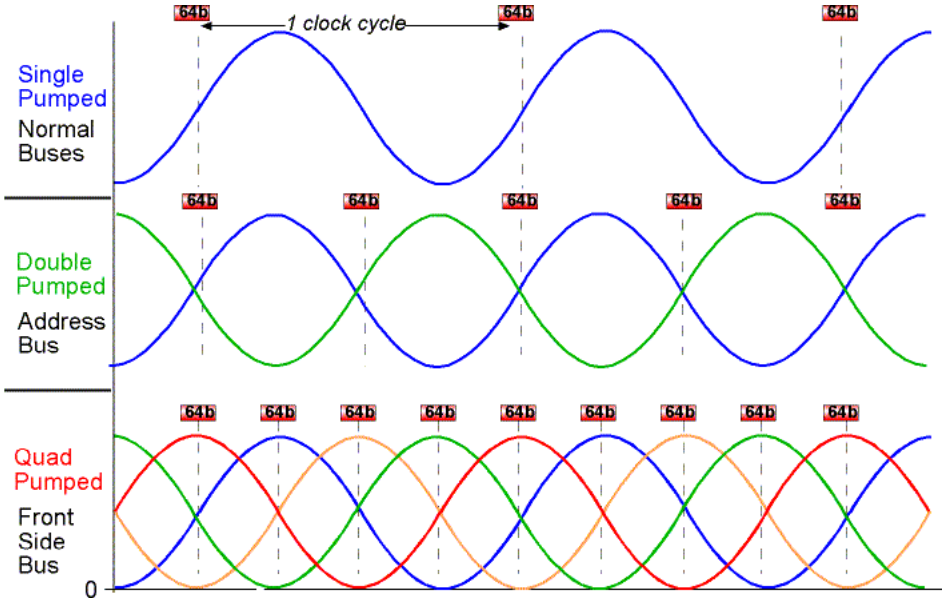
transistors into the circuit. Feature size is a major limiting factor in processing speed: As the feature size decreases, the processing speed increases and the power requirements decrease. The 0.13-micron Xeon processor has a smaller feature size and faster circuitry than 0.18-micron Intel processors.

HP manufactures the DL560 microprocessor/heatsink assembly as a single piece. It includes an alignment mechanism to prevent damage to the processor during installation and pin protection to prevent damage when the processor is placed on a flat surface.

### 400-MHz front side bus

All data transfers go to and from the processor over the front side bus (FSB). The Intel Xeon processor MP has a 64-bit, quad-pumped bus running at 100 MHz. A normal (single-pumped) bus sends, or latches, data out once per clock cycle on the rising or falling edge of the bus clock signal. A quad-pumped bus latches data at four times the rate of a normal bus (Figure 5). This faster rate is achieved by means of four overlapping clock strobes, each operating 90 degrees out of phase with the next. Data is transmitted on the rising edge of each of the four strobes, four times per clock cycle. This makes it possible to transfer 3.2 GB/s of data on a 100-MHz FSB, which is triple the data rate of the Pentium III FSB (1.06 GB/s with a 133-MHz FSB).

**Figure 5.** Comparison of clock signals for a quad-pumped and a single pumped 100-MHz front side bus




Note: Only the data is quad pumped on these buses. The address bus for the processor is double pumped.

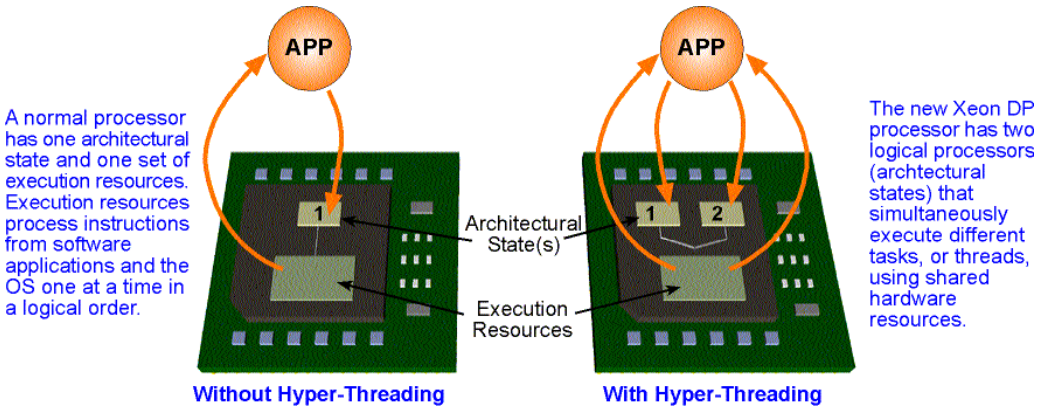
### NetBurst Microarchitecture

The Intel Xeon processor MP features Intel NetBurst microarchitecture. The NetBurst microarchitecture supports MP speeds of up to 2.80 GHz and doubles the pipeline depth in the processor to enable 400-MHz core frequency. NetBurst microarchitecture also adds a Rapid Execution Engine and Advanced Dynamic Execution. The Rapid Execution Engine allows the two integer Arithmetic Logic Units (ALUs) in the processor to run at twice the core frequency, which increases performance by allowing many integer instructions to execute in one half of the internal core clock period. Advanced Dynamic Execution improves speculative execution and branch prediction internal to the processor.

### Hyper-Threading technology

The Intel Xeon processor MP features Intel Hyper-Threading technology, which enables a single processor to execute two applications or processes at one time by handling instructions in parallel. A processor without Hyper-Threading technology has one architectural state and one set of execution resources on the processor core (see Figure 6 left). The architectural state is a set of registers that track program execution, and the operating system (OS) views this set of registers as one logical processor. The execution resources process instructions from the OS and applications one at a time in a logical order. During each clock cycle, a typical operation uses only a fraction of the execution resources while the rest are idle. Hyper-Threading technology boosts processor utilization by using as many execution resources as possible during each clock cycle.

**Figure 6.** Schematic showing how Hyper-Threading technology works

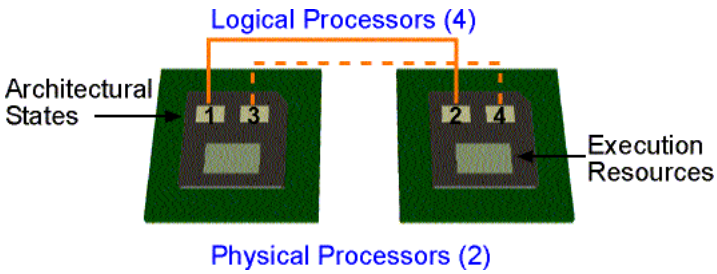



The OS views a processor with Hyper-Threading technology as if it were two logical processors—two architectural states sharing one set of execution resources. This allows the processor to simultaneously execute incoming instructions from different software applications by using out-of-order instruction scheduling to keep execution resources as busy as possible. As a result, a processor with Hyper-Threading technology can execute as many instructions as 1.5 processors. The result is a performance boost during multi-threading and multi-tasking operations. The actual performance increase depends on the independent operations being executed and the execution resources required to complete the operation.

In a multiprocessing system, the OS manages the tasks performed by all processors in the system. To take advantage of multiple processors, applications must be multi-threaded, which means they must be capable of splitting instructions into multiple streams, or threads. The OS can allocate various software threads to run on more than one processor simultaneously, which results in improved performance. But the OS first needs to know the number of available processors so it can distribute the optimum number of threads among the processors.

The system BIOS counts the number of processors so the OS can create the optimum number of software threads for better load balancing. A table in the system BIOS records the number of processors and tags each one as a physical or logical processor. Figure 7 illustrates the counting order. The system BIOS counts the first logical processor on each physical processor. Then, in the same sequence, the system BIOS counts the second logical processor on each physical processor. This ensures that the OS uses separate physical processors as often as possible to maximize performance.

**Figure 7.** The system BIOS counts processors.




The method of counting physical and logical processors determines per-processor license compliance. In a two-processor system like the one in Figure 7, if the OS cannot differentiate between physical and logical processors, the system exceeds the license limit for a two-processor OS. Microsoft® Windows® 2000 Server products, for example, count logical processors; once the count reaches the license limit, these operating systems will not use other available logical processors. On the other hand, Windows Server 2003 products count only the physical processors and therefore use all the logical processors. For example, Windows Server 2003, Standard Edition has a two-processor licensing limit. However, in a two-processor system using Xeon processors with Hyper-Threading technology, Windows Server 2003 operating systems can get the benefit of four logical processors. The table that records the processors in the BIOS allows Windows Server 2003 to resolve logical processors to their associated physical processors.

Operating systems that are aware of Hyper-Threading schedule application threads to run on logical processors in the same way they manage physical processors. With Hyper-Threading technology, an OS schedules threads not only to separate processors, but also to separate logical processors on a single physical processor.

Because of the way the OS counts and identifies processors, the OS always schedules threads to logical processors on different physical processors before scheduling multiple threads to the same physical processor. This optimization allows software threads to use different physical execution resources when possible.

The second logical processor can be turned off when it is not needed. A HALT instruction is issued to the inactive logical processor. Without this instruction, an OS may execute on the idle logical processor a sequence of instructions that repeatedly checks for work to perform. This so-called "idle loop" can consume significant execution resources that the active logical processor could otherwise be using.

If needed, system administrators can disable Hyper-Threading in the ROM-Based Setup Utility (RBSU). This action may be necessary for testing or verifying performance gains for enterprise applications. Also, it is possible that some applications not designed for Hyper-Threading may not perform as well with Hyper-Threading turned on.

For additional information about Hyper-Threading, visit Intel's Hyper-Threading Technology website at www.intel.com/technology/hyperthread/index.htm.

### Multilevel cache system

Another important feature of the Intel Xeon processor MP is its integrated Level 3 (L3) cache architecture, which increases throughput to memory for improved performance.

The value of caching lies in the probability that a processor will again need information it has recently accessed in system memory. Just as a carpenter uses a tool belt to keep frequently used tools nearby,

the processor uses the cache to hold the most recently used information close for faster and more efficient access.

Typically, there are two levels of cache memory: primary Level 1 (L1) cache and secondary Level 2 (L2) cache. The L1 cache resides within the processor core and holds 8 kilobytes (KB) of recently accessed data. In addition to this L1 cache, the Intel Xeon processor MP also includes an Execution Trace Cache that stores up to 12 KB of decoded micro-operations instructions to speed up instruction throughput and improve response times.

The Intel Xeon processor MP has a 512-KB L2 Advanced Transfer Cache that consists of a 256-bit (32-byte) interface that transfers data on each core clock. This L2 cache stores recently accessed data that is not being held in the L1 cache. When the processor needs data, it first looks in the L1 cache. If the information is in the L1 cache (known as a cache hit), the processor uses it without a performance delay. If the information is not in the L1 cache, the processor next searches the L2 cache.

In the L2 cache, stored data is organized in columns and rows. Each row, or cache line, contains 64 bytes (512 bits) of data. To optimize performance, the OS writes data to or reads data from the L2 cache as a complete 512-KB cache line. The 512-bit cache line size in the Intel Xeon Processor MP is twice the size of the cache line in the Intel Pentium® III processor. As a result, there is greater chance of a cache hit for any given memory request.

When a cache hit occurs in the L2 cache, the data is transferred at 2.8 GHz to the processor core along a 32-byte interface on each core clock cycle. As a result, the 512-KB L2 Advanced Transfer Cache can deliver a data transfer rate of 89.6 GB/s to the processor so that it can keep executing instructions instead of sitting idle. This compares to a transfer rate of 16 GB/s for the 1-GHz Intel Pentium III processor.

To improve performance of enterprise class applications, the Intel Xeon processor MP also includes an integrated L3 cache available in 2-MB or 1-MB options. Coupled with the 400-MHz system bus, this L3 cache provides a high bandwidth path to memory. The integrated L3 cache provides a fast path to large data sets stored in cache on the processor. The result is reduced average memory latency and increased throughput for large server workloads.

**Note:**
ProLiant DL560 servers with Intel Xeon processors MP that run at 1.50, 1.90, 2.0, or 2.5 GHz have a 1-MB L3 cache; ProLiant DL560 servers with Intel Xeon processors MP that run at 2.00 and 2.8 GHz have a 2-MB L3 cache.

## Memory subsystem

The hyper-dense ProLiant DL560 server contains six memory sockets. To provide the desired memory capacity and performance, this server uses 200-MHz Double Data Rate (DDR) Synchronous Dynamic Random Access Memory (SDRAM); that is, PC2100 Registered SDRAM. DDR SDRAM is a next-generation SDRAM technology. SDRAM data is transferred on the rising edge of every clock cycle. However, the memory chip on DDR DIMMs performs transactions on both the rising and falling edges of the clock cycle, effectively doubling memory bus clock rate yields. With a doubling of the clock rate yields, the 200-MHz memory bus matches the throughput of the 400-MHz front side bus of the Intel Xeon Processor MP. The GC-LE chipset provides dual memory channels that provide 3.2 GB/s bandwidth.

The ProLiant DL560 server comes standard with 1024 MB of system memory on most models and is expandable to 12 GB. Because the ProLiant DL560 features 2-way memory interleaving architecture

for increased memory performance, memory must be expanded two DIMM modules at a time. HP offers option kits for expanding system memory.

**Advanced memory protection**

Advanced Error Checking and Correcting (ECC) memory functionality is standard on all ProLiant DL560 servers. Advanced ECC technology detects and corrects single-bit and specific multi-bit errors (4-bit and 8-bit errors occurring on a single DRAM chip on a DIMM).

As an option, HP Advanced Memory Protection is available for the ProLiant DL560 server. Advanced Memory Protection is designed to maintain server availability and memory reliability without service intervention. The ProLiant DL560 server includes support for OS-independent online spare memory: If the number of single-bit correctable errors on a memory bank exceeds the pre-defined error threshold, that bank will fail over to the online spare bank without intervention or server interruption. Online spare memory can be configured across one or two memory cards. The failed memory can then be replaced at the user's convenience during a scheduled maintenance window.

All HP Advanced Memory Protection options are user configurable through the ROM-Based Setup Utility and are viewable through Insight Manager 7 and the Integrated Management Log.

**2-way interleaved memory**

The ProLiant DL560 server uses two-way interleaving to improve memory performance. Two-way interleaving works by dividing memory into multiple 64-bit blocks that can be accessed two at a time, thus doubling the amount of data obtained in a single memory access from 64 bits to 128 bits and reducing the required number of memory accesses. Reducing the number of memory accesses also reduces the number of wait states, which further improves performance.

When the processor writes data to memory, the memory controller distributes, or interleaves, the data across two DIMMs in a particular memory bank. When the processor requests a cache line of data, the memory controller retrieves 32-bit blocks of data from both DIMMs in the addressed bank.

In addition to the requested data, the controller retrieves data from subsequent sequential memory addresses on both DIMMs in anticipation of future data requests. The retrieved blocks of data are merged together in 128-bit lines on the memory bus. The data is sent to the L2 cache as four 128-bit lines (512 bits) to match the cache line size in the Intel Xeon Processor. The data rate on the memory bus matches the data rate on the quad-pumped processor bus (3.2 GB/s), which reduces latency in memory reads and writes.

Dual-interleaved memory fills the processor cache faster than standard, non-interleaved memory systems so that the processors can execute applications faster. This synergy between the processor and memory subsystems boosts the overall system performance of the ProLiant DL560 server well beyond that of 2P or 4P servers without Hyper-Threading technology and two-way memory interleaving. In fact, system performance truly scales with the number of processors: depending on the application, a ProLiant DL560 server fully configured with four processors may outperform two dual-processor servers.

## I/O subsystem

The ServerWorks GC-LE chipset ensures that the bandwidth of the I/O subsystem complements the processor and memory bandwidths. The chipset supports I/O bandwidth of 6.4 GB/s across two Inter Module Buses (IMBs), supporting up to four independent PCI-X buses.

In the ProLiant DL560 server (Figure 2), IMB1 connects two embedded NC7781 10/100/1000 Port PCI-X gigabit network interface controllers (NICs) and an integrated Smart Array 5i Plus storage controller that supports two Ultra2 or Ultra3 SCSI internal disk drives or one disk drive and an internal tape device. This storage controller supports the simplex drive cage and Dual Channel, Wide Ultra3 technology; but the ProLiant DL560 server uses only one channel. The storage controller supports up to 64 MB of read cache on the 5i Plus Memory Module. With the addition of an optional write cache

Enabler Kit, this read cache can be converted into a battery-backed, 64-MB write cache that is fully transportable and provides 72-hour data protection. The Enabler Kit ships with ProLiant DL560 2P models, but it is an option for 1P models.

External storage solutions require the addition of a PCI or PCI-X option card. IMB2 connects three I/O expansion slots (none of which is hot pluggable):

- Two full-length 64-bit/100-MHz PCI-X slots, 3.3-volt
- One full-length 64-bit/133-MHz PCI-X slot, 3.3-volt

PCI-X technology provides a significant improvement in performance beyond that of conventional PCI systems. The performance improvements are a result of two primary differences between conventional PCI and PCI-X: higher clock frequencies—made possible by the register-to-register protocol—and protocol enhancements such as the attribute phase and split transactions. For more information on these performance improvements, read "PCI-X: An Evolution of the PCI Bus," document number TC990903TB, available on the HP website at ftp://ftp.compaq.com/pub/supportinformation/papers/tc990903tb.pdf.

The GC-LE chipset uses a thin IMB to connect the host bridge to the south bridge. The South Bridge provides interfaces to the following I/O devices:

- Integrated Lights-Out (iLO) controller on the system board
- Integrated ATI Rage XL video controller with 8 MB of SDRAM video memory
- Integrated 1280 x 1024, 16M color on the PCI local bus
- Two USB ports
- Support for a slot-based Remote Insight Lights-Out Edition (RILOE) II controller

## Storage subsystem

The ProLiant DL560 server ships standard without internal disk drives. The internal Wide Ultra3 SCSI backplane supports an internal hot-plug Ultra3 drive cage with up to two 1-inch disk drives or one HP StorageWorks internal AIT tape drive. The system supports up to 293.6 GB internal hot-plug drive storage (2 x 146.8-GB one-inch Wide Ultra320 SCSI disk drives) with Redundant Array of Inexpensive Disks (RAID) Level 0 or 1 protection across the internal disk drives.

The server is Ultra320 ready. Running at Ultra320 speeds will simply require the use of Wide Ultra320 drives and installation of a Wide Ultra320 array controller when they become available. The ProLiant DL560 server does not have an external SCSI port. Running external drives requires the installation of a slot-based controller.

The storage subsystem includes a 1.44-MB slim line diskette drive and a slim line removable media bay with a 24x IDE CD-ROM drive. The CD-ROM drive is ejectable for improved security and serviceability. The system also supports one multibay that can be used for a CD, DVD, or a planned CD read/write and DVD combination drive.

## Power and cooling

HP developed the ProLiant DL560 server especially for customers looking to maximize the power and cooling efficiency of their rack space while maintaining high levels of performance when running back-office and enterprise business applications. HP engineers designed the system to support anticipated processor speed and cache upgrades through the year 2004. The ProLiant DL560 server uses low-wattage, ultra-efficient power supplies that can run fully configured using either low-line or high-line power sources. The flexibility of low-line or high-line AC power enables customers to scale capacity when planned and unplanned upgrades become necessary.

The ProLiant DL560 server requires just two 550-Watt hot-plug power supplies to run a fully loaded and redundant system. It has the lowest power requirements of any major server in its class. One power supply ships standard with 1P server models, but an optional Redundant Hot-Plug Power Supply Option Kit is available. Two power supplies ship standard on 2P models. The server uses a standard C14 power cord.

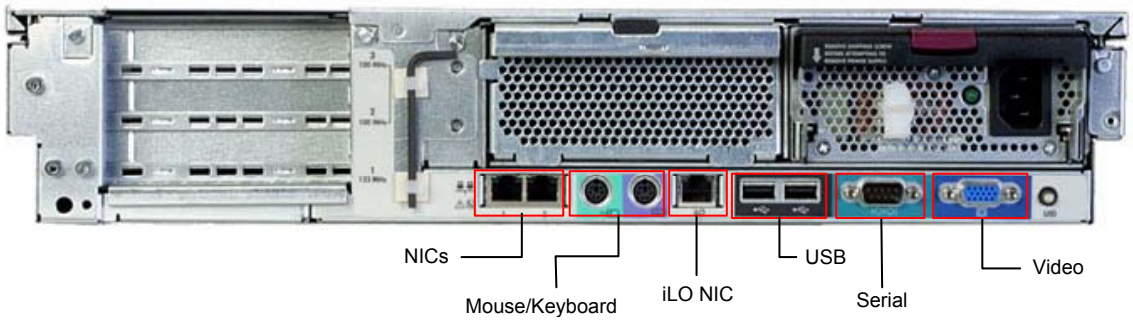
With its limited memory footprint and drive capacity, the ProLiant DL560 server can deliver enterprise-class performance with a relatively low thermal load. The server has an innovative mechanical design that provides excellent cooling and ventilation that dissipate generated heat out of the chassis quickly. The design features redundant cooling zones across major server subsystems (memory, I/O, processor) that provide 7x24 cooling. Each zone is independent of the others and is able to support n+1 redundancy. Because no preheated air circulates toward the processors, the fans can cool efficiently while spinning much slower than in many other servers.

HP engineers chose one fan design for use throughout the ProLiant DL560 server. The 1P models come standard with five of these fans; the 2P models come standard with ten fans. Each fan in the system is hot-pluggable and individually removable. The system can run fully loaded with five fans. The zone cooling configuration enables the server to withstand up to three fan failures, if those failures are not all within the same zone.

## Racking technology

HP designed the dense ProLiant DL560 server to overcome challenges associated with deploying a high concentration of servers in a single rack. The server ships standard with tool-free, snap-in sliding rails with a depth adjustment range of 24 to 36 inches and a cable management system. This solution provides good access to the rear cabling connections (Figure 8). Moreover, it allows the server to be extended fully from the rack and temporarily locked in place for servicing, without removing the cables from the server.

**Figure 8.** ProLiant DL560 rear cable connections




For added flexibility, the server design supports deployment in rack cabinets with round holes: The Round-Hole Rack Rail kit includes variable-length rack rails compatible with 610-mm (21-inch) to 740-mm (29.13-inch) round holes. ProLiant DL560 servers can be deployed in two-post Telco racks with the use of the HP DL380 G3 Telco Rack Kit. For details about deployment in Telco racks, visit this web page: www.racksolutions.com/hp.

HP 9000 and 10000 Series Racks provide enhanced airflow for maximum cooling, so that they can be fully loaded with servers using the latest and fastest processors. Blanking panels should always be installed in any empty rack U-spaces to ensure proper airflow. Installing servers with processors running at speeds of 550 MHz or greater in legacy Compaq 7000 Series Racks requires installation

of HP High Airflow Rack Door Inserts to ensure the required airflow for adequate cooling of the servers.

For additional information about deploying the ProLiant DL560 server, refer to the Setup and Installation Guide and the Documentation CD provided with the server, or to the server documentation located in the Support section of the HP website at the following URL: www.hp.com/servers/dl560.

# Hardware reusability

For the ProLiant DL560 server, a key design goal was developing an ultra-dense server with a significant number of reusable components to reduce cost and simplify parts inventory for customers. HP achieved that goal by using many standard components in the server:

- Standard DDR SDRAM memory and the same memory spares option kits used for the ProLiant DL380 server
- The same standard processor power modules, rack and rail kit, and Smart Array 5i Plus storage controller as used for the ProLiant DL380, DL580, and DL360 servers
- A single hot-plug fan model throughout the ProLiant DL560 server

# Deployment, management, and troubleshooting technologies

HP provides hardware technologies and many software tools to simplify deployment, management, and troubleshooting of ProLiant servers. The ProLiant DL560 server ships standard with the ProLiant™ Essentials Foundation Pack, which includes:

- SmartStart system configuration software
- ROMPaq support software and configuration utilities
- Insight Manager 7 event and configuration management
- Management Agents
- ActiveUpdate
- Survey Utility and diagnostics utilities

For the ProLiant DL560 server, HP also offers optional software tools that simplify server configuration, automate server deployment, and enable companies to adapt quickly and easily to changing business demands. The optional software includes the SmartStart Scripting Toolkit and the following ProLiant Essentials Value Packs:

- Rapid Deployment Pack (RDP)
- Workload Management Pack (discussed in a later section of this paper)
- Performance Management Pack

Each of the tools supported by the ProLiant DL560 server is described briefly in the following sections.

## Deployment technologies

**SmartStart**

SmartStart is a set of server integration tools and utilities that optimizes platform configuration and simplifies setup for ProLiant servers. Embedded ROM-based utilities configure the server and array controller hardware. SmartStart performs dependency and validity checks to ensure that all software required for supporting the desired server configuration can be installed. SmartStart prepares the system for installing "off-the-shelf" versions of leading OS software and provides an easy-to-use,

intuitive graphical interface that guides users through the OS installation process. SmartStart completes server setup by installing ProLiant Support Packs, which are OS-specific bundles of ProLiant optimized drivers, utilities, and management agents that are ready to be managed with Insight Manager 7. SmartStart streamlines single-server setup and provides an efficient way to deploy reliable and consistent server configurations. More information about SmartStart is available on the HP website at www.hp.com/servers/smartstart.

**SmartStart Scripting Toolkit**

The SmartStart Scripting Toolkit is an optional deployment tool for automated, unattended installation for high volume server deployments. The SmartStart Scripting Toolkit supports ProLiant DL and ML series servers. It includes a modular set of utilities and important documentation that describes how to apply these new tools to build an automated server deployment process.

Used in conjunction with SmartStart technology, the SmartStart Scripting Toolkit provides a flexible way to create standard server configuration scripts to automate many manual steps in the server configuration process. The resulting time savings make it possible to scale server deployments to high volumes in rapid fashion.

More information about the SmartStart Scripting Toolkit is available at www.hp.com/servers/sstoolkit.

**Rapid Deployment Pack**

The ProLiant Essentials Rapid Deployment Pack is an optional solution for automated, unattended configuration, deployment, and provisioning of one or many servers. The RDP combines two powerful products—the Altiris eXpress Deployment solution and the ProLiant Integration Module—to provide an easy "drag and drop" solution for deploying a standard server configuration from a remote console.

The Altiris eXpress Deployment Solution uses Pre-boot Execution Environment (PXE) technology to provide complete hands off deployment of servers using a network boot process. PXE provides a common set of pre-boot services that allow one or more PXE-enabled clients on a heterogeneous network to acquire an IP address from a Dynamic Host Configuration Protocol (DHCP)[2] server and then download a boot image from a PXE boot server. The embedded NICs in the ProLiant DL560 server provide PXE support.

For information about how PXE works, see the technology brief "Implementing Rapid Deployment Pack and PXE in an Enterprise Network Environment," available at www.hp.com. More information about RDP is available from the HP website at www.hp.com/servers/rdp.

## Management technologies

The ProLiant DL560 server incorporates a combination of hardware and software technologies that enable IT organizations to:

- Recognize, diagnose, and respond proactively to OS or server problems remotely
- Increase uptime
- Respond quickly to downtime events to reduce the loss of business revenue
- Reduce operating costs

[2] DHCP is defined by RFC 1531, 2131.

### Sensors and indicators

System health LEDs and the Unit Identification Lights on the front and back of the ProLiant DL560 server make pinpointing system issues easier than ever. Inside the server, thermal sensors on the Intel Xeon processor MP enable the system to actively monitor and manage thermal conditions and reduce the chance of system failure. The processor also includes Error Correction Code (ECC) on the integrated three-level cache architecture to maintain the integrity of mission-critical data. The Intel Xeon processor MP also comes with a System Manageability Bus (SMBus) that enables efficient communications between components and allows for easy access to system manageability information stored in the Processor Information ROM. These features of the Intel Xeon processor MP provide platform-level manageability for reliable, robust server operation and ease of management.

### Insight Manager 7

Insight Manager 7, the core of the ProLiant Essentials Foundation Pack, is a comprehensive management tool designed specifically to monitor and control the operation of HP servers, clusters, desktops, workstations, and portables. It also manages devices from other vendors, if those devices are instrumented to the Simple Network Management Protocol (SNMP) or the Distributed Management Interface (DMI).

Insight Manager 7 consists of two components: server-based or client-based management agents and a Windows-based console application. The agents for Microsoft Windows, NetWare, and Linux operating systems are web-enabled. Insight Manager 7 is accessible through a standard web browser and provides seamless access to the HP Insight Management Agents, the Integrated Lights-Out, and Remote Insight Lights-Out Edition. Insight Manager 7 makes critical management information available from any location accessible via a local area network (LAN), wide area network (WAN), or secure remote connection.

Insight Manager 7 automatically discovers devices in the network and enables remote management from anywhere. Key subsystems in HP devices make health, configuration, and performance data available to the agent software. The management agents monitor more than 1,000 operating parameters, provide updated management information such as network interface or storage subsystem performance statistics, and initiate alarms in the event of faults.

Insight Manager 7 identifies, isolates, and proactively notifies IT staff via email or pager of potential problems before they result in costly downtime or reduced productivity. Moreover, Insight Manager 7 Version Control and Inventory Reporting functionality enables system administrators to update server BIOS, drivers, and agents, as well as create detailed inventory reports, without leaving their desks.

More information about Insight Manager 7 is available online at www.hp.com/servers/im7.

### Lights-out technology

The ProLiant DL560 server includes an iLO application-specific integrated circuit (ASIC). The iLO device is an autonomous management processor that resides on the system board. It contains its own processor, memory, and network interface, which allow it to operate independently from the state of the OS or other server hardware.

iLO provides remote browser access to ProLiant servers through a seamless, hardware-based, OS-independent Remote Console. Insight Manager 7 and the management agents are tightly integrated with iLO, allowing administrators to view subsystem and status information from a web browser. Furthermore, an administrator can use the query mechanism of Insight Manager 7 to discover each iLO device and store it on a device list. The device list provides direct hyperlink access to each iLO device, giving the administrator a single location for accessing all Lights-Out management devices (including Remote Insight Lights-Out Edition II).

Using iLO, IT administrators can manage a ProLiant server remotely through its entire life cycle (initial deployment, operation, and redeployment), with the ability to respond quickly to downtime events, diagnose OS or server problems remotely, increase uptime, and reduce the loss of business revenue.

The ProLiant DL560 server ships standard with the following iLO Standard capabilities:

- Virtual Text Remote Console
- Virtual Power Button Control
- Dedicated LAN Connectivity
- Automatic IP Configuration via DHCP/DNS/WINS
- Industry standard 128-bit Secure Sockets Layer (SSL) security
- IML and iLO event logging
- Support for 12 user accounts with customizable access privileges

For customers who want full front-of-the-server, remote control of their servers, HP offers the optional ProLiant Essentials Integrated Lights-Out Advanced Pack, software that can be activated via a purchased license key. This Advanced Pack provides sophisticated virtual administration features for full control of servers in data centers and remote locations. Using the iLO Advanced features, an administrator can install, configure, monitor, update, and troubleshoot remote ProLiant servers from anywhere at any time via a standard Web browser. On the ProLiant DL560 server, the Integrated Lights-Out Advanced Pack supports these additional iLO capabilities: Graphical Remote Console and Virtual Floppy.

Each iLO device can be configured individually in one of three ways: through the ROM-Based Setup Utility (RBSU), through the web browser interface, or through a scripted setup. For information about how to configure iLO for optimal use, read the white paper "Best Practices for Integrated Lights-Out," document number TC030606BP, available on the HP website.

As mentioned in the "I/O subsystem" section of this paper, the ProLiant DL560 server also supports the HP RILOE II board. This board provides similar functionality as the iLO device with even higher performance. However, installing the RILOE II board requires use of one of the three PCI-X slots in the server. More information about the RILOE II board is available at http://h18004.www1.hp.com/products/servers/management/riloe2/index.html.

**ActiveUpdate**

ActiveUpdate 2.0 is a web-based client application that keeps IT administrators directly connected to HP for proactive notification and delivery of the latest ProLiant software updates. ActiveUpdate now delivers Product Change Notifications, Customer Advisories, and management application updates.

## Troubleshooting technologies

**Survey Utility**

The HP Survey Utility is a powerful troubleshooting tool for IT administrators and service providers. It is an agent that runs on ProLiant servers, gathering critical hardware and OS information. The Survey Utility captures data as sessions and maintains up to 10 distinct sessions at a time. For Windows and NetWare systems, session information is stored in an output file called SURVEY.IDI in a binary format that can be used for generating custom reports. A SURVEY.TXT file contains system information in a text file format. For Linux systems, information for each session is output to an individual text file.

Typical uses of the Survey Utility include:

- Capturing the hardware and operating system configuration of a server
- Recording critical information for documentation and disaster recovery
- Comparing historical configurations on the same server or another (baseline) server
- Sending configuration information to another location for in-depth analysis
- Generating custom reports providing configuration audit trail detail

System administrators can analyze Survey Utility output files locally using the Survey Utility, or they can send the output files to HP Customer Services or a third-party service provider for further analysis.

**Performance Management Pack**

ProLiant Essentials Performance Management Pack (PMP) is a performance management solution that detects, analyzes, and explains hardware performance bottlenecks on ProLiant servers and attached options. With the PMP software, system administrators can interactively display performance information on one or more servers, log the information to a database for later analysis or reporting, and set up proactive notification using the Insight Manager 7 notification mechanism.

PMP is installed on the same server as the Insight Manager console. PMP functionality requires no software on the monitored server except for the management agents required for use of Insight Manager 7. A browser is the only software required on the client machine used to view PMP information.

# Consolidation technologies

The ProLiant DL560 server supports two optional software solutions for server consolidation: Resource Partitioning Manager and VMware GSX Server.

## Resource Partitioning Manager

Resource Partitioning Manager (RPM), the featured component of the HP ProLiant Essentials Workload Management Pack, is an automated solution for multi-server deployment and provisioning. With this solution, system administrators can control and dynamically allocate system resources for application consolidation and performance optimization on ProLiant servers. This capability enables companies to adapt quickly and easily to changing business demands, maximize use of computing resources, and improve availability.

Once RPM has been installed on the managed server, system administrators can access RPM both directly from that server and from other networked servers running RPM to perform four basic functions:

- Create Resource Partitions: An administrator creates resource partitions on a target server by establishing a name and defining which processors and how much memory the partition will include.
- Assign Processes: An administrator chooses which executables, DLLs, and services will run within the resource partition. In doing so, the administrator ensures that these processes will use only the assigned partition resources.
- Define Rules: The administrator can use the Dynamic Rules Engine to establish rules allowing objects to dynamically increase or decrease processor and memory resources as needed.
- Evaluate Configuration and Performance: RPM provides allocation, utilization, and performance graphs that give administrators quick performance information and feedback.

RPM is a good solution for customer environments in which:

- Each application instance can co-exist in a single system image.
- Applications require more than one processor.
- Dynamic online, automatic resource allocation is required.
- Windows 2000 (and beyond) is the target OS.

More information about the HP ProLiant Essentials Workload Management Pack and RPM is available at http://h18004.www1.hp.com/products/servers/proliantessentials/wmpdescription.html.

## VMware GSX and ESX Server

Through an extended partnership with VMware, HP provides a VMware solution for IT consolidation projects. VMware is virtualization software for consolidating and partitioning enterprise servers. It is ideally suited for corporate and service provider data centers as it brings mainframe-like virtual machines to industry-standard computers. VMware has two server products—GSX Server and ESX Server—for departmental and enterprise servers, respectively.

The ProLiant DL560 server is a certified platform for GSX Server, which is designed for two- to four-processor workgroup, departmental, and smaller enterprise servers. GSX Server runs as an application on top of Windows or Linux server operating systems to provide transportable, scalable virtual machines. On a single physical server, GSX Server enables the rapid creation of multiple virtual servers, each running Microsoft Windows® NT, Microsoft Windows 2000, or Linux, plus applications in a secure, resource-protected environment. It enables customers to consolidate multiple operating systems and applications in virtual machines on the same ProLiant DL560 server. This solution allows for a more efficient use of processors, memory, bandwidth, and other server resources, which lowers the overall total cost of ownership, for production, test, and development environments.

VMware is a good solution for customer environments in which:

- Multiple or even disparate OS support is required on a single physical server.
- The application is single threaded or is required to run in a single instance of the OS.
- Applications are "untrusted" or the interaction between different applications running on the same OS is undefined.
- The customer does not want to change the existing software architecture.

More information about VMware is available at
http://activeanswers.compaq.com/ActiveAnswers/Render/1,1027,5361-6-100-225-1,00.htm

# Conclusion

The HP ProLiant DL560 server delivers enterprise class performance in a compact 2U form factor that uses 50 percent less rack space than most other enterprise servers on the market. This server shares the same chipset and basic architecture as the ProLiant DL380 G3 server, but it features the much more powerful Xeon MP processor. HP's unique 4-way implementation of the ServerWorks GC-LE chipset provides the combination of performance, scalability, and power and cooling efficiency that customers need for running back-office and enterprise business applications. Moreover, HP engineers designed the system to support anticipated processor speed and cache upgrades through the year 2004.

Teamed with either the HP Resource Partitioning Manager or VMware GSX Server software solution, the ProLiant DL560 server is an excellent platform for server consolidation. HP provides many software tools to simplify deployment, management, and troubleshooting of ProLiant servers. HP also offers many optional software tools that simplify server configuration, automate server deployment, provide remote management and troubleshooting, and enable companies to adapt quickly and easily to changing business demands.

## For more information

For more information about the HP ProLiant DL560 server, go to www.hp.com/servers/dl560.

For more information about optional HP ProLiant Essentials software offerings, go to www.hp.com/servers/proliantessentials.

## Call to action

To help us better understand and meet your needs for ISS technology information, please evaluate this paper by completing the short survey at www.zoomerang.com/survey.zgi?JTKEG49MB3PT6B2P1QJFR294

**Note:** This URL will be active through October 31, 2003. Please send questions and further comments about this paper to: TechCom@HP.com.



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